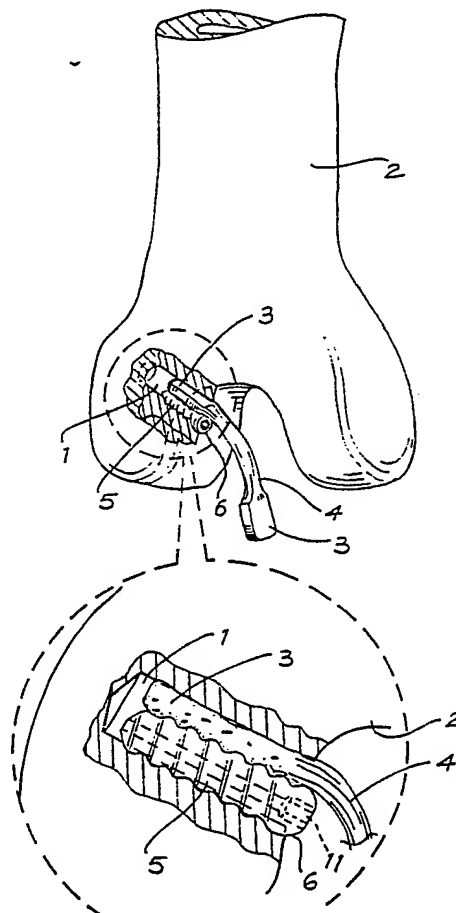


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification 5 :</b> <b>A61B 17/58, A61F 2/08</b> <b>F16B 35/06</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 92/03980</b> <b>(43) International Publication Date:</b> 19 March 1992 (19.03.92)
<b>(21) International Application Number:</b> PCT/AU91/00405 <b>(22) International Filing Date:</b> 30 August 1991 (30.08.91)  <b>(30) Priority data:</b> PK 2119 4 September 1990 (04.09.90) AU  <b>(71) Applicant (for all designated States except US):</b> HIP DEVELOPMENTS PTY. LTD. [AU/AU]; 286 Pacific Highway, Crows Nest, NSW 2065 (AU).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> ROGER, Gregory, James [AU/AU]; PINCZEWSKI, Leo, Arie [AU/AU]; 286 Pacific Highway, Crows Nest, NSW 2065 (AU).		<b>(74) Agent:</b> F.B. RICE & CO.; 28A Montague Street, Balmain, NSW 2041 (AU).  <b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i>

**(54) Title:** SURGICAL SCREW**(57) Abstract**

A surgical screw (5) having a head (6) being, at least in a portion (8), hemispherical. A smooth continuous join exists between the head (6) and a shank (7) of the screw (5), the head (6) being of the same, or larger, diameter as the shank (7). To drive the screw a drive socket (11) is provided concentrically within the head, and a cannulation (9) is provided concentrically of the shank (7) and it opens into the socket (11) so as to allow the screw (5) to be threaded along a guide wire (not shown) or similar. The shank (7) has a smooth or soft thread so as to provide an interlocking fixation of a bone end of a tendon graft within a prepared hole of a bone, but without damaging either bone structures. The hemispherical portion (8) provides a smooth continuous curved surface over which a graft may flex and move without fatigue or suffering stress concentrations.



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<sup>+</sup> Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

## SURGICAL SCREW

### Background Art

This invention relates to surgical screws which are particularly well adapted for securing Patellar Tendon  
5 Grafts during reconstruction of the Anterior Cruciate Ligament.

Damaged Anterior Cruciate Ligaments can be repaired by grafting a Patellar Tendon physiologically bound to blocks of bone at each end, between the femur and tibia  
10 within the knee joint. The graft is inserted into a prepared hole and initially bound by a screw inserted within the hole beside the graft bone. After time the graft fuses with the bone material. While this technique works generally well problems can occur in that the head  
15 of the screw rests against the graft material and, as the knee is bent and the graft swings around, the head of the screw acts as a fulcrum for the graft and can damage the graft fibres. Other problems can occur in that conventional screw threads will cut into, and therefore  
20 damage, the graft. Also conventional screws can, in some procedures, be lost into the knee joint cavity causing a longer than necessary operation and further trauma.

### Disclosure of the Invention

According to one broad form, the present invention  
25 provides a surgical screw having a shank and a head with a generally hemispherical head portion of a diameter substantially the same as an overall diameter of the shank proximate the head or having a greater such diameter and another head portion tapering smoothly down to the shank.

30 Preferably the screw is cannulated and a socket drive, such as a hexagonal socket drive, is formed in the screw head.

Preferably a sinusoidal, or other soft, thread form is used along the entire length of the screw.

### Brief Description of Drawings

By way of example only, one preferred embodiment of the invention will now be described with reference to the drawings in which:

5        Fig. 1 is a schematic representation of the knee joint end of a femur in which a screw according to the invention has been inserted;

      Fig. 2 is a schematic sectional view of a screw incorporating the present invention;

10       Fig. 3 is a view, similar to Fig. 2, of a modified embodiment of the invention; and

      Fig. 4 is a schematic representation of the Patellar Tendon Graft which may be anchored using a screw such as that shown in Fig. 2.

### 15    Best Mode of Carrying Out Invention

      When repairing damaged Anterior Cruciate Ligaments, a blind hole 1 is drilled into the knee joint section of the femur 2 and a bone end 3 of a Patellar Tendon Graft 4 is inserted into the hole 1 where it is secured in place by  
20 driving in a screw 5. The screw head 6 lies generally under the Tendon Graft 4 and thus, once the knee is again put into normal use, the Tendon Graft 4 will be led over the screw head 6 and there will be some mutual movement between the two.

25       Although the screw 5 should not actually cut the bone 3 of the Tendon Graft 4, it must interlock its thread portions with both the bone 3 and inside wall of the hole 1 in order to maintain bone 3 rigidly positioned for the necessary period of time for it to fuse to the  
30 femur 2. Thus, as seen in Fig. 2 the thread form of the screw 5 is sinusoidal in longitudinal section, that is, it has no outermost cutting line which would normally helically follow the thread crest.

      The screw head 6 has a surface which extends smoothly  
35 and continuously from the general shank 7 into a

hemispherical end portion 8. Central of the head 6, and aligned with the longitudinal axis of the screw 5, is a hexagonal socket 11 for accepting a mating hexagonal drive to screw the screw 5 into its position. The radius of the  
5 hemispherical end portion 8 will generally be in the order of 4mm as the typical screw for this operation will be of an overall diameter of 8mm, or thereabouts.

As shown in Fig. 3, the head portion 8 may also be of greater diameter than the screw shank 7, the head portion  
10 being a greater part-sphere with a smooth transition to a frusto-conical collar 10 tapering down to the shank 7.

Of course, the screw 5 may be used in other operative situations where a screw of significantly different diameter is preferred, the head 6 will generally remain  
15 approximately hemispherical with a smooth transition to the shank.

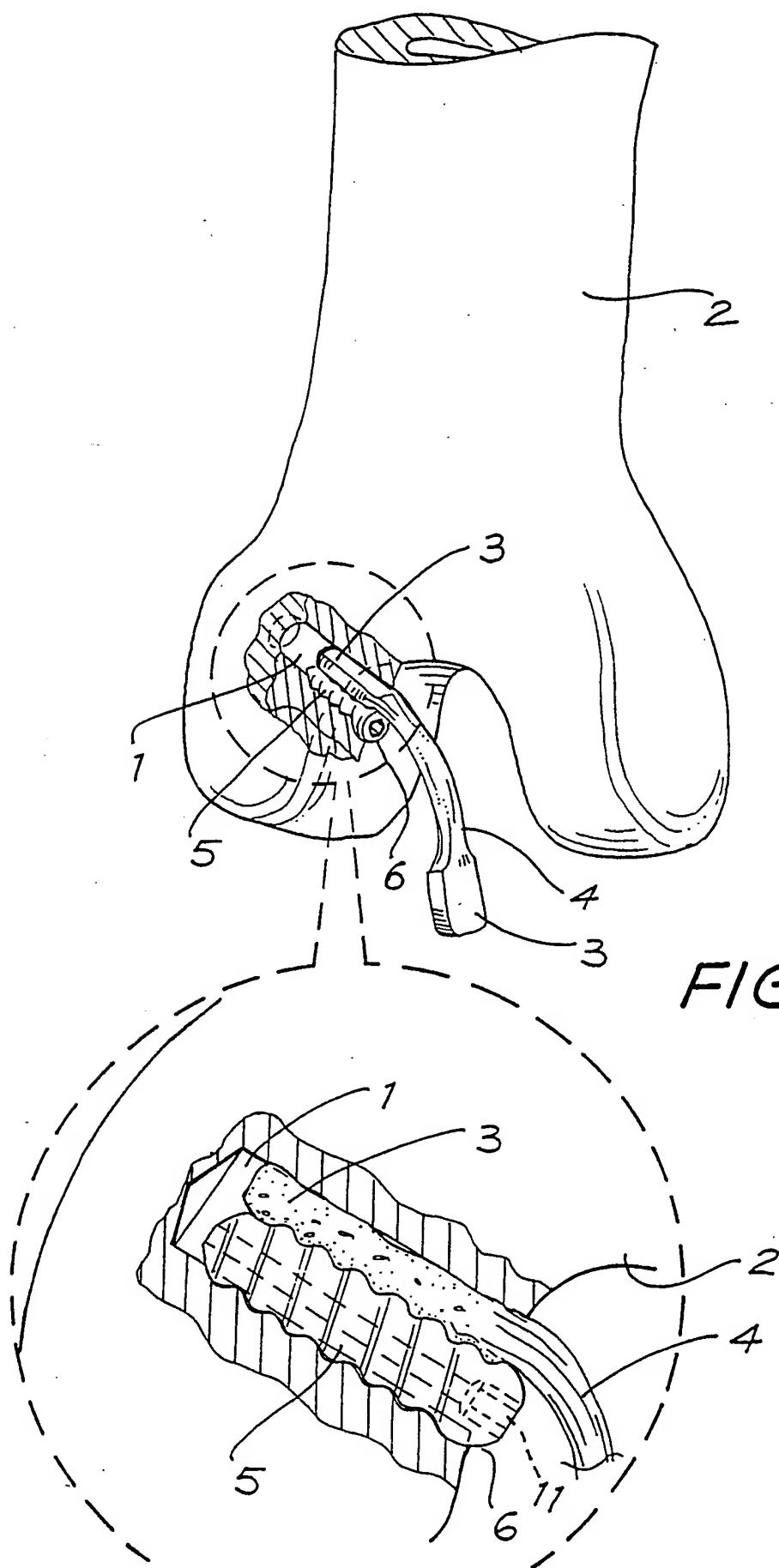
In order to more easily lead and align the screw 5 as it is first inserted into hole 1, a central cannulation 9 is included along the length of the screw 5. The  
20 cannulation 9 allows the screw to be handled by a large diameter Kirschener wire, or similar, thus the diameter of cannulation 9 would typically be in the order of 2.4mm.

CLAIMS:

1. A surgical screw having a shank and a head with a generally hemispherical head portion of a diameter substantially the same as an overall diameter of the shank proximate the head or having a greater such diameter and another head portion tapering smoothly down to the shank.
2. A surgical screw as defined in claim 1 wherein the screw has a central cannulation running generally longitudinally thereof.
3. A surgical screw as defined in claim 2 wherein the screw includes a socket drive within the head and communicating with the cannulation, the socket drive being adapted to connect in a torque transferring manner a corresponding drive device.
4. A surgical screw as defined in claim 3 wherein the socket drive is a hexagonal socket drive.
5. A surgical screw as defined in claim 1 wherein the screw includes a thread which, in longitudinal section along the entirety of the thread, is devoid of an outermost cutting line.
6. A surgical screw as defined in claim 5 wherein the screw thread is sinusoidal in longitudinal section.
7. A surgical screw having a shank and a head with a generally hemispherical head portion of a diameter substantially the same as an overall diameter of the shank proximate the head, a soft thread substantially along the length of the shank of the screw, a drive socket concentric of the head and a longitudinally running cannulation concentric of the shank.
8. A surgical screw having a shank and a head with a generally hemispherical head portion of a diameter greater than an overall diameter of the shank proximate the head and another head portion tapering smoothly from the hemispherical head portion down to the shank, a soft thread running substantially along the shank, a drive

socket concentrically within the head and a cannulation running concentrically within the shank.

9. An anchoring means for anchoring a tendon graft, by a bone end of a tendon graft placed within a prepared hole
- 5 within a bone, the anchoring means comprising a screw with a soft threaded shank and an approximately part spherical head so as to provide, by the part spherical head, a smooth continuous surface over which the tendon graft may flex and move in use.
- 10 10. A surgical screw as defined in claim 1 when used to anchor a bone end of a tendon graft within a hole of a bone by providing an interlocking of the bone end and the interior of the hole in the bone by virtue of the thread and by providing a smooth continuous surface over which
- 15 the tendon may flex and move in operation by virtue of a substantially hemispherical head portion being positioned under the tendon graft.

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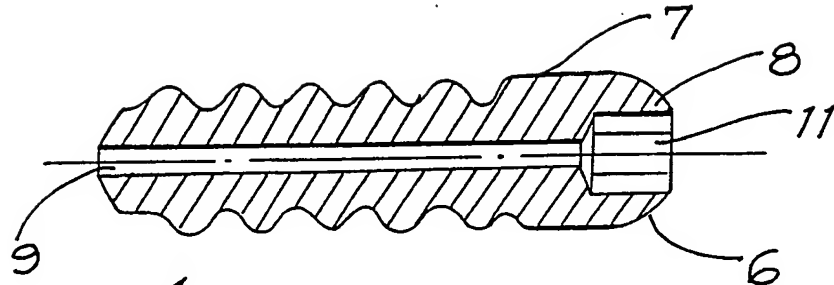


FIG. 2

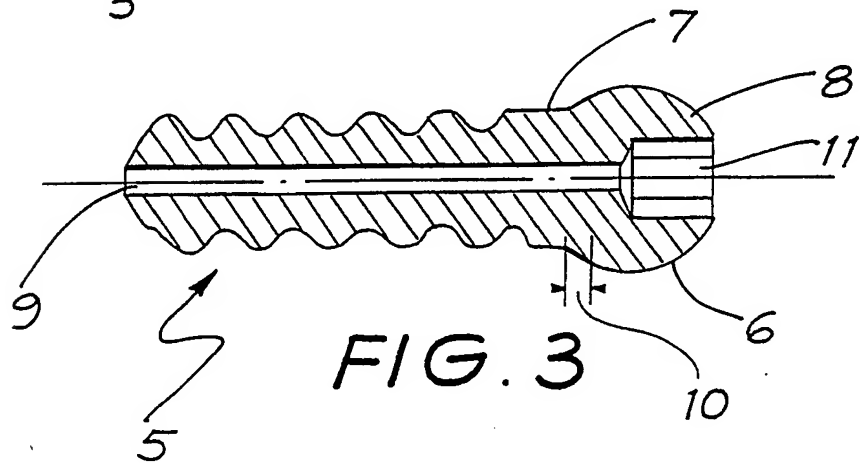


FIG. 3



FIG. 4

# INTERNATIONAL SEARCH REPORT

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent classification (IPC) or to both National Classification and IPC  
Int. Cl.<sup>5</sup> A61B 17/58, A61F 2/08, F16B 35/06

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>7</sup>

Classification System

Classification Symbols

IPC

A61B 17/58, 17/18, A61F 1/24, 2/08, F16B 35/06

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>

AU : IPC as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup>

Category <sup>*</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate of the relevant passages <sup>12</sup>	Relevant to Claim No <sup>13</sup>
X,Y	EP,A, 374088 (GERBRUDER SULZER AG) 20 June 1990 (20.06.90). See Figs 1, 3, 4 and 6.	(1-5, 7-10)
X	AU,A, 14615/28 (FLANNERY BOLT COMPANY) 12 February 1929 (12.09.20). See Fig 1, Col 2 lines 4-12.	(1)
P,X	AU,A, 59999/90 (MINNESOTA MINING AND MANUFACTURING COMPANY) 21 February 1991 (21.02.91). See Fig 1, page 7 lines 4-11.	(1)
X	EP,A, 172130 (MECRON MEDIZINISCHE PRODUKTE GMBH) 19 February 1986 (19.02.86). See Figs 1, 4 and 5.	(1-4)
(continued)		

\* Special categories of cited documents : <sup>10</sup>

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search  
26 November 1991 (26.11.91)

Date of Mailing of this International Search Report

29 November 91

International Searching Authority

Signature of Authorized Officer

AUSTRALIAN PATENT OFFICE

A. HENDRICKSON



**III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)**

Category*	Citation of Document, <sup>11</sup> with indication, where appropriate of the relevant passages <sup>12</sup>	Relevant to Claim No <sup>13</sup>
Y	EP,A, 317406 (LABOUREAU) 24 May 1989 (24.05.89)	(1, 2, 7, 10)
Y	WO,A, 90/08510 (ACUFLEX MICROSURGICAL INC) 9 August 1990 (09.08.90). See page 3 lines 1-4, page 16 line 14 - page 17 line 20, Figs 10 and 11.	(2-4)
A	FR,A, 2622790 (SOCIETE MATCO S.A.R.L.) 12 May 1989 (12.05.89)	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT ON**  
**INTERNATIONAL APPLICATION NO. PCT/AU 91/00405**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
EP	374088				
AU	59999/90	CA 2021577 US 5002574	EP 413549	JP 3092150	
EP	172130	DE 3434807			
EP	317406	FR 2623082			
WO	9008510	AU 51667/90 FI 904905	CA 2026781	EP 411109	
FR	2622790				